[Day 3, Session 2, #42] *ISMRM Workshop on Perfusion MRI: Standardization, Beyond CBF & Everyday Clinical Applications, 11-14 Oct. 2012, Amsterdam, The Netherlands*

Using negative signal in mono-TI pulsed arterial spin labeling to outline pathological increases in arterial transit times

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Purpose

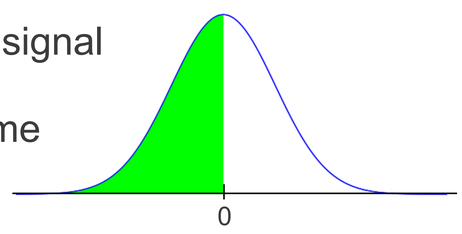
Context: With the PICORE Q2TIPS PASL sequence (3T Siemens Verio MR scanner; VB17), using a single Time of Inversion (TI), we frequently observe significantly negative perfusion estimates.

Problem: Though isolated negative values could be attributed to noise, clusters of significant negative signal should be explained by another phenomenon.

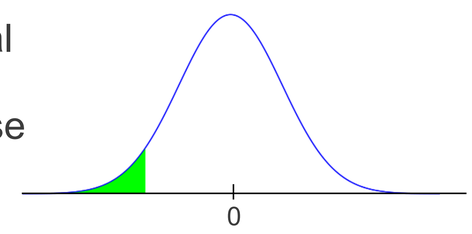
Significantly negative signal

In order to outline areas of significantly negative perfusion signal, we computed a univariate t-test, with a p-value of 0.05 (uncorrected) againt the null hypothesis H_0 that the mean signal equals zero.

In areas where the perfusion signal is null, **negative perfusion** estimates arise **50%** of the time due to the noise.



In areas where the perfusion signal is null, **significantly** ($p<0.05$) **negative perfusion** estimates arise **5%** of the time due to the noise.



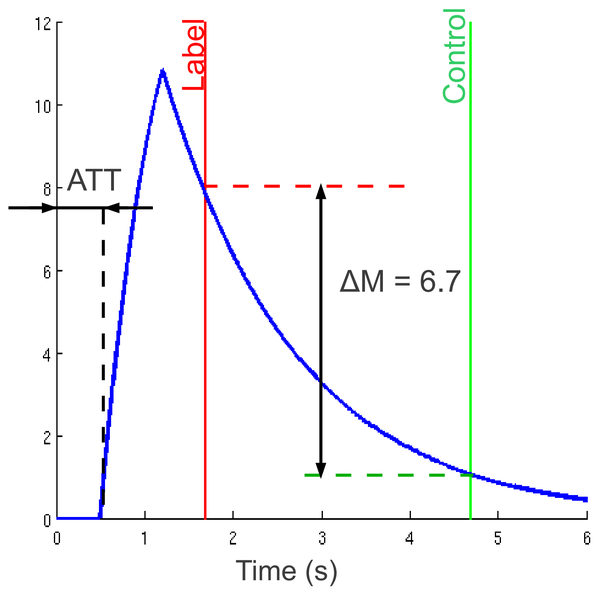
Though isolated negative values could be attributed to noise, clusters of significant negative signal should be explained by another phenomenon.

Theoretical model of the perfusion signal

Perfusion component found in the labelled and control scans against time for short and long arterial transit times (ATT):

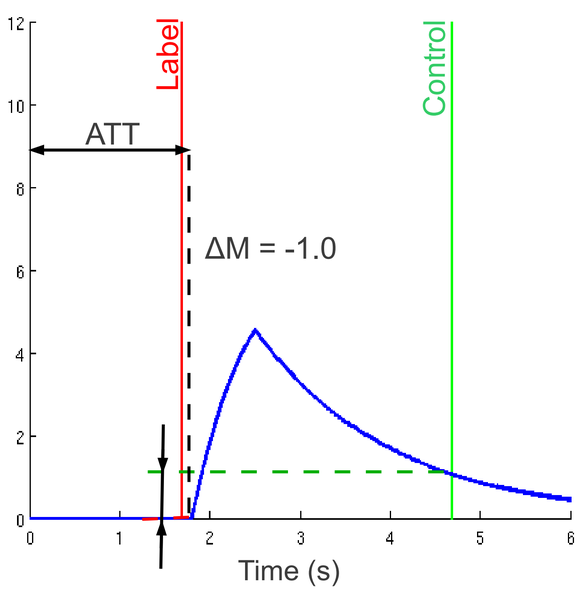
Short arterial transit time

TI > ATT + bolus width



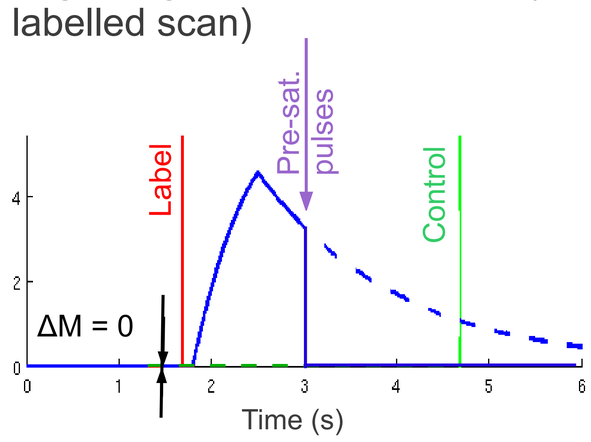
Long arterial transit time

TI < ATT



In plane pre-saturation pulses

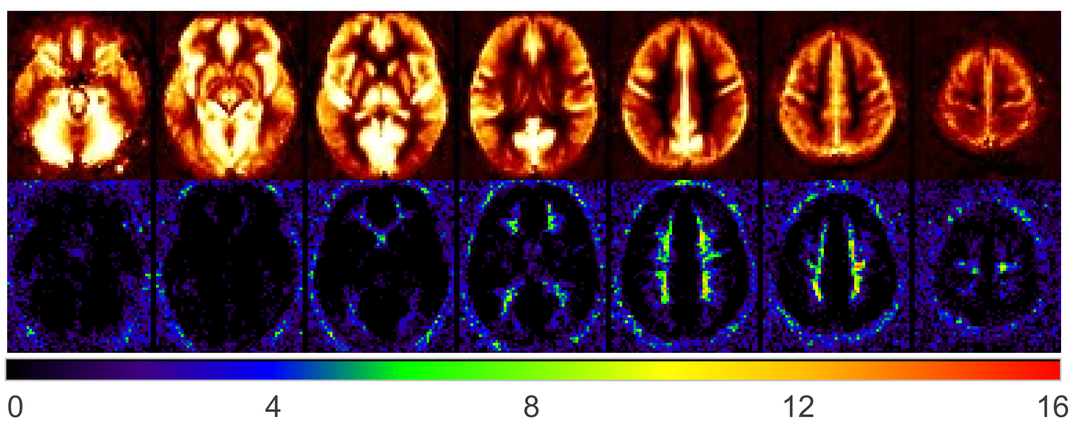
In theory, given the presence of pre-saturation pulses, the signal should be nulled at the beginning of each acquisition (control or labelled scan)



Location of negative perfusion estimates

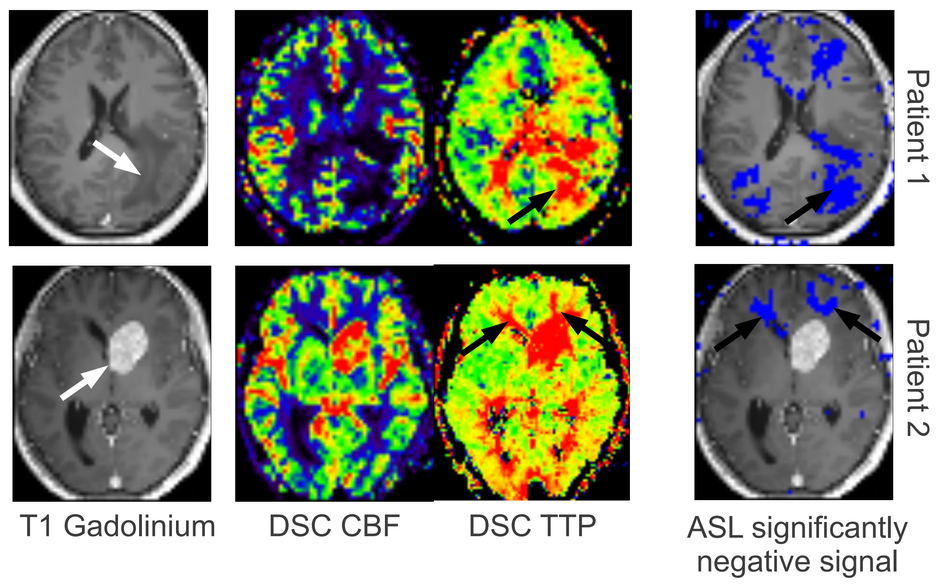
Healthy subjects

Voxel-wise map of the number of subjects (out of 36), presenting a significantly negative perfusion estimate:



Negative perfusion estimates are confined to deep white matter, which is a region of the brain known to have long arterial transit times.

Patients diagnosed with brain tumors



Areas of significant negative signal are collocated with increased time to peak (TTP) as extracted from Dynamic Susceptibility Contrast imaging (DSC).

Conclusions

Based on these results, we advise to systematically check for negative perfusion signal before computing any type of analysis based on mono-TI PICORE Q2TIPS PASL perfusion maps. In pathological condition, areas outlined as significantly negative can indicate increased arterial transit times.